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The study of the space topographic models using fractal methods and harmonic multi-parametric analysis

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Abstract

© 2018, American Institute of Aeronautics and Astronautics Inc, AIAA. All rights reserved. In the implementation of the space missions on the solar system exploration, a significant amount of data on planets' geophysics and morphological properties was obtained. This has allowed creating a new scientific direction which is comparative planetology. It focuses not only on the development of evolutionary and cosmogonic concepts but on the description of natural phenomena occurring on celestial bodies as well. The aim of the present paper is to investigate a topographic model of the Earth (Global Digital Elevation Model – GDEM) based on the measurements taken by ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) which is installed on the platform of Terra (NASA) space mission using the multi-parametric harmonic analysis and the methods of fractal geometry. It should be noted that self-similarity and scale invariance of the objects studied with the fractal analysis methods allow describing the structure of the Earth's surface properly. The multi-parametric harmonic analysis and expansion in a series of spherical functions were used during the construction of the model of the Earth's physical surface on the basis of GDEM data. In the present work, the values of fractal dimension of the Earth's surface which has inhomogeneous structure are determined. The fractal dimension values are obtained for geographical latitudes depending on longitude values set. The Earth's macrostructure independent estimates, which could be used for the new interpretation of geophysical processes, are presented. For certain areas of the Earth's surface, the fractal dimensions are agreed well. Thus, the comparative fractal analysis allows studying celestial bodies' marcosurface constructed on the basis of space missions data and investigating not only their inhomogeneous structure but the processes of their evolution as well.

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